WHITCHURCH-STOUFFVILLE CHEMICAL TESTING PROGRAM

INTERIM REPORT
MAY, 1982

Laboratory Services Branch
Ontario Ministry of the Environment

MOE
WHI
AMVR

c.1
a aa

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

WHITCHURCH-STOUFFVILLE CHEMICAL TESTING PROGRAM

INTERIM REPORT
MAY, 1982

Laboratory Services Branch
Ontario Ministry of the Environment

amur

Table of Contents

Page

I Acknowledgements 1

II Introduction 2

III Study Outline 3
- A. Private Wells 3
- B. Landfill Site Wells 3
- C. Objectives 3

IV Characterisation of Leachate Well #5 5
- A. Analytical Methods and Results 5
- B. Discussion 9

V Analysis of Ballantrae Plaza, Hutchinson and Observation Wells 10
- A. Introduction and Outline of Analytical Work 10
- B. Analytical Results - Background Well at Ballantrae Plaza 15
- C. Analytical Results - Hutchinson Well 19
- D. Analytical Results - Observation Wells 22
- E. Discussion 29

VI Conclusions 36

VII Appendices 38
- A. Analytical Data Tables 38
- B. GC/MS Analysis by Mann Testing Laboratory on Ballantrae Plaza and Hutchinson Wells 60

I ACKNOWLEDGEMENTS

Many analysts from Laboratory Services Branch have been involved in the provision of data for this study. The following principal scientific investigators of the Laboratory Services Branch have made major contributions to the findings and interpretations presented in this report. The study was co-ordinated and much of the field sampling carried out by staff of the Central Region office:

Laboratory Services Branch	Central Region
M. Glenys Foster	Alex Giffen
Otto Meresz	Ken Hogg
Joseph Osborne	Walter Painting
Jane E. Pagel	Derek Smith
Gerald A. V. Rees	Louise Zerter
R. Dean Smillie	
George Wyhovszky	

II INTRODUCTION

The waste disposal area, known today as York Sanitation No. 4 landfill site has been the subject of investigations dating back to the days of the Ontario Water Resources Commission. Further to a continuous quarterly monitoring program that commenced in 1976 and extensive analytical testing of selected private wells during the summer of 1981, the Ontario Ministry of the Environment initiated an in-depth chemical and biological study in December 1981. The present investigation is a follow-up of the finding of a university laboratory which in November 1981 reported bacterial mutagenicity in a concentrated water sample from one of the Whitchurch-Stouffville private wells adjacent to the York Sanitation No. 4 landfill site.

The design of the study and selection of wells was discussed with the town's consultant and citizens' representatives to obtain their input and agreement. The selected wells and sampling schedule were as follows:

Jan. 25	Ballantrae Plaza (background well)
Feb. 8	Hutchinson (adjacent to landfill site)
Feb. 22	M.N.R. (background well)
Mar. 8	Fockler (adjacent to landfill site)
Mar. 22	Tranmer (control well)
Mar. 29	Coughlan (control well)

This interim report details the chemical testing program undertaken in conjunction with the mutagenicity testing program.

III STUDY OUTLINE

A. PRIVATE (OFF-SITE) WELLS

In conjunction with the mutagenicity testing program, samples were subjected to very extensive chemical and microbiological testing. In an attempt to provide the most exhaustive analytical approach possible, samples were extracted and analysed by gas chromatography/mass spectrometry (GC/MS) both by MOE and an outside private laboratory.

B. LANDFILL SITE WELLS

A highly specific "fingerprinting" approach was applied to three on-site observation wells (OW 16-70, OW 2-75 and OW 1-80) and also to leachate well 5. These wells were selected in co-operation with the town's consultant and the Stouffville residents at the meeting held in Stouffville on January 5, 1982, as these wells reflected the highest on-site level of contamination based on regular monitoring data. After applying the newly available priority pollutant scan, GC/MS is used to identify as many as possible of a wide range of compounds. This combined technique, which is being applied for the first time, is capable of detecting some compounds not normally detected in routine scans. By this approach it is hoped that specific constituents identified in the observation or leachate wells can then be screened for in private wells to provide a more specific indicator of any potential migration from the landfill site.

C. OBJECTIVES

This interim report is intended to provide preliminary findings on the first two test wells and on the "fingerprint" observation and leachate wells. All available, confirmed data are presented with discussions included where findings are considered significant. Analyses are still ongoing, particularly on the fingerprinting of on-site well samples where complex, multistage testing and confirmation is required. Complete details on the methods and data will be presented in the final report to be prepared after the conclusion of the mutagenicity and chemical testing program. The objectives of this study can be summarized as follows:

1) To analyse leachate well 5 in order to identify and determine the nature and levels of on-site chemicals.

2) To analyse the selected observation wells to identify any chemicals appearing in the on-site groundwater.

3) To analyse the selected private wells to determine whether compounds detected on-site are appearing in the private drinking water supplies.

4) To establish, by exhaustive chemical testing using a fingerprinting approach, a trace organic profile which can be used to test for any present or future migration which might create a health hazard in off-site private wells, and which will provide a chemical data base to complement any mutagenicity test findings.

IV CHARACTERISATION OF LEACHATE WELL #5*

This section of the report describes the various analytical methods used in characterising the major components of leachate well 5. Multistage testing and confirmation is required for this complex sample and analyses are still in progress.

A. ANALYTICAL METHODS AND RESULTS

1) Sample Description

Leachate well 5 is stratified with an oily layer of approximately 0.5 to 1.0 metres in the upper zone of a 7.7 metre liquid column. The oil fraction represents the major organic components in this well and all the analytical work has concentrated on characterising and profiling the oil make-up. The oil layer from leachate well 5 consisted of a light brown coloured material with a strong, unpleasant p-cresol type odour.

2) Gas Chromatography of Sample as Received

The sample as received was assigned code No. OR01-0019. Analysis was carried out using documented standard conditions for routine petroleum hydrocarbons. Because some volatile components were expected, gasoline and diesel fuel standards were run first for comparison.

A 5 uL aliquot of sample OR01-0019 was dissolved in 1 mL of n-hexane and 5 uL of this solution was injected into the gas chromatograph.

The gas chromatogram obtained indicated a mixture of gasoline and lubricating-type oil. Components characteristic of diesel fuel and home heating oil were absent.

---

* In this and subsequent sections where results are discussed, concentrations are expressed as milligrams per litre (mg/L = ppm = one part in 1,000,000), micrograms per litre (ug/L = ppb = one part in 1,000,000,000) or nanograms per litre (ng/L = ppt = one part in 1,000,000,000,000).

3) Determination of Volatile (Low Boiling) Components

Approximately 500 mg of sample OR01-0019 was weighed into an evaporating dish and heated over a steam bath for 18 hours. The quantity of volatile fraction was calculated as the weight loss.

Loss of volatiles: 24.3%

4) Fingerprinting (IR) of the Oil as Received and after Evaporation of Volatiles

Samples were introduced to demountable sodium chloride cells and their infrared spectra (4000 cm^{-1} - 650 cm^{-1}) were recorded using a Beckman 4240 infrared spectrophotometer.

The recorded spectra will serve as reference for comparison with samples collected from the same leachate well in future monitoring.

The spectra indicated that the material consisted mainly of a wide variety of hydrocarbons of petroleum origin with relatively wide boiling range. The presence of other types of organic materials was indicated by a sharp ester band at 1740 cm^{-1} as well as some aromatic compounds (based on absorption at 1610 cm^{-1} and 810 cm^{-1}). The presence of phosphate esters was also indicated at 970 cm^{-1}. The last two groups of components, however, can be constituents from petroleum products.

5) Separation and Characterisation of Components

An aliquot of the residue obtained on removal of the volatile components was separated by column chromatography with sequential serial elution. Fractions were characterised by infrared spectrophotometry as follows:

a) paraffinic base oil	73.5%
b) petroleum derived aromatic compounds	10%
c) compounds similar to b) with some changes in component ratios	2%
d) polar oxygenated organics containing carbonyl groupings with possible traces of organic phosphates	11%
e) column hold-up	3.5%

6) Gas Chromatography of Polarity Separated Fractions

The gas chromatograms obtained for fractions a-d supported the characterisation by infrared spectroscopy. Fraction b) showed one sharp peak in a general hydrocarbon envelope. No attempt was made to run the gas chromatogram of fraction e) because the system is set-up for the characterisation of petroleum hydrocarbons and not for polar organics.

7) Total Potential and Leachable Phenol Content

An aliquot of the leachate well oil was extracted with 1% aqueous potassium hydroxide. This alkaline extract was analysed for phenol using the Gibbs method which gave a value of 70 mg/L. From this result, the original concentration of phenol in the oil was calculated:

Total potential phenol content: 291 mg/kg oil or
253 mg/L oil

In the determination of leachable phenol content, an aliquot of oil was mixed with distilled water and stirred by magnetic stirrer for 8 hours. Gibbs analysis for phenols gave a value of 6 ug/L in the diluted extract. From this, the original leachable phenol content can be calculated:

Leachable phenol content: 10 mg/kg oil of phenolics
8.6 mg/kg phenolics/L of oil

8) Gas Chromatographic Determination of Volatile Aromatic Hydrocarbons and Halogenated Components

This scan was carried out for the routine analysis of 38 organics (30 hydrocarbons and 8 widely used chlorinated solvents). The so-called headspace analysis was used where a known quantity of the sample in a sealed vial is heated in a thermostatically controlled bath at 85° for 1 hour. A known volume of the headspace gases is injected into a gas chromatograph equipped with dual flame ionization and electron capture detectors. The former is sensitive to hydrocarbons and the latter to halogenated compounds.

In addition to 11 aliphatic hydrocarbons, 8 aromatic compounds and 5 chlorinated species were detected and quantitated. Concentrations of the significant aromatic and chlorinated compounds quoted below should be regarded as under-estimates owing to the oil substrate which will hold a considerable fraction of the volatiles even at elevated temperatures (Table 1).

Compound	Estimated concentration (mg/L)
Benzene	22
Toluene	328
Ethylbenzene	236
p-Xylene	174
m-Xylene	383
o-Xylene	190
Cumene	7
Styrene	6
Methylene chloride	0.53
Carbon tetrachloride	0.03
Chloroform	0.01
Trichloroethylene	0.30
Tetrachloroethylene	0.09

9) Analysis for PCBs and Phosphate Esters

Analyses for PCBs were carried out on this set of samples and two earlier samples collected from leachate well #5 in August and September, 1981.

The raw oil samples were extracted, cleaned-up on Florisil columns and analysed using electron capture gas chromatography. The chromatograms obtained demonstrated an excellent fit with Aroclor 1248, a commercial PCB mixture containing 48% chlorine. The levels detected in the oil samples were:

August 11, 1981	2,250 ppm (0.225%)
September 4, 1981	3,200 ppm (0.320%)
January 7, 1982	3,000 ppm (0.300%)

The oil sample of January 7, 1982, was separated by column chromatography and various fractions screened by gas chromatography using a nitrogen/phosphorus specific detector. The presence of trialkyl, aryl-alkyl and triaryl phosphates was indicated and estimated at the ppm levels in the oil. Further work for the detailed identification of these phosphate esters is in progress. The oil was specifically checked for the presence of tri(dichloropropyl)phosphate but none was detected in the fractions analysed to date.

B. DISCUSSION

Over 96% of the oily material obtained from LW #5 could be characterized as petroleum hydrocarbons (gasoline, lubricating and process oils) and high boiling esters such as plasticizers.

PCBs were found at levels of 3,000 ppm and various organophosphate esters at lower trace concentrations. Thus, the oily waste represents a significant potential to contaminate the aquifer if its transport were allowed by soil and hydrogeological conditions. Should such event take place in the future, the readily leachable phenolic components (10 ppm) are expected to be detectable even after 1000x dilution and give ample warning of impending contamination by more toxic components such as PCBs which are not transported by water readily. The mobility of phenols in water and soil equals that of the chloride ion and in soils of high ion exchange capacity they may even precede inorganic chlorides. Thus the monitoring of surrounding private wells for phenolics can be regarded as an excellent indicator for potential contamination from this particular source.

V ANALYSIS OF THE BALLANTRAE PLAZA AND HUTCHINSON WELLS AND SELECTED OBSERVATION WELLS

A. INTRODUCTION AND OUTLINE OF ANALYTICAL RESULTS

This section of the report gives an account of the analytical work and findings on two off-site wells included in the mutagenicity study: one background well (Ballantrae Plaza) and the first of two private wells adjacent to the landfill site (Hutchinson). Also presented is the analytical summary for three observation wells on the landfill site. The analytical data tables (2-18) are included in Appendix A at the end of this report.

Samples from wells included in the chemical/microbiological testing (January and February, 1982) were taken simultaneously with those required for the mutagenicity study. Observation wells were sampled in January 1982, specifically for this study, and supplemental data for metal analyses have been added from the regular quarterly monitoring survey, November 1981.

All well samples were analysed for general water quality parameters and metals. The analytical investigation for trace organics included the following scans and techniques:

1) Priority Pollutant Scan by high resolution dual capillary column gas chromatography for 80 organic compounds most commonly occurring in toxic industrial wastes. Also included are analyses for PCBs, organochlorine pesticides and trace metals.

2) Volatile organohalide scan for six most frequently occurring organohalides.

3) Gas Chromatographic/Mass Spectrometric scan for volatile organics.

4) Gas Chromatographic/Mass Spectrometric scans for extractable organics. Extractions are carried out under strongly alkaline and then acidic conditions to furnish "base neutral" and "acidic" fractions, respectively. The analytical sensitivity of this scan was increased five-fold over standard procedures by the injection of a correspondingly larger aliquot.

The following is a description of the analytical procedures used in GC/MS analysis:

a) Sample Concentration

In order to carry out GC/MS analysis of trace organic compounds one has to concentrate the organics present in the sample in a suitable solvent. This is carried out by an extraction procedure into methylene chloride as solvent. Prior to the extraction procedure an internal standard is added to the sample. This internal standard is chosen as a compound which is unlikely to appear in any environmental sample. The purpose of its addition is to monitor that the extraction has occurred successfully and that the conditions of the GC/MS analysis have not changed markedly. In addition it acts as an indicator for quantitative purposes, since we add a known amount of it to each sample.

b) Analysis

After extraction, a portion of the sample is introduced to the GC/MS instrument. The gas chromatograph acts to separate the components of a complex mixture on the basis of the speed with which different compounds are able to pass through the column. Over a period of time, as each compound (or group of compounds) exits from the column, it is presented to the mass spectrometer. The molecules of the separated compounds are then broken up in the mass spectrometer to give ionised fragments. These fragments give a pattern characteristic of a particular compound or class of compounds. These patterns, called mass spectra, are stored in a computer together with the time during the analysis when they appeared.

c) Interpretation

Interpretation of the mass spectra obtained has to be undertaken in order to identify the components present. In addition GC/MS is a useful tool for determining whether particular compounds or groups of compounds are present in a sample. As each compound elutes from the column at a certain time and fragments in a characteristic way, one can search the data collected and if specific fragments or indicators are not found at the right time, then the compound is not present.

The identification of the compounds which produce a particular fingerprint of ionised fragments is a much more difficult task. A number of factors need to be considered including:

(i) Time of elution

(ii) The possibility of a mixture of compounds with quite different chemical characteristics appearing at the same time and yielding confused spectra.

(iii) Different compounds with the same elution time may give quite similar spectra.

(iv) The possibility that the fragments seen can be reconstructed to yield compounds which are naturally occurring or are introduced by normal human activity, by the sampling or by the analytical process as opposed to compounds of definite industrial origin.

The computer can assist in the interpretation by carrying out a comparison of the "unknown" to mass spectra of over 25,000 compounds stored in the computer library. In a very complex sample, manual interpretation has to be carried out by a skilled mass spectrometrist. This interpretation is based on the analysis of the mass spectrum obtained by the instrument together with a knowledge of organic and environmental chemistry to attempt to identify the compounds. The manual interpretation is usually done with reference to the library of over 25,000 compounds in the computer and to reference documents listing mass spectra obtained in other laboratories.

When a computer library search is carried out the normal requirements for an identification are a computer "fit" of greater than 80% with the library mass spectrum. On occasion, the mass spectra of a chemical class of compounds show general similarities and it is difficult to distinguish the members of that class. Such is the case when one considers aliphatic hydrocarbons.

The certainty of identification, in most cases is based mainly on the inspection of the mass spectra. Little other comparative analytical data is available for evaluation because of the wide variety of compounds observed by this technique. In order to increase the degree of confidence in the identification an authentic standard must be analysed under identical analytical conditions. Many of the compounds identified as trace organics in environmental samples are not in fact available commercially as pure compounds suitable for standards.

This manner of interpretation is an accepted approach and is classified as Level II in terms of confidence level in a document entitled "Master Scheme for the Analysis of Organic Compounds in Water - Interim Protocols" prepared by Analytical Sciences Division, Chemistry and Life Sciences Group, Research Triangle Institute for the U.S. E.P.A.

In the case of samples received from Whitchurch-Stouffville, an attempt has been made to make the methodology five times more sensitive than our normal analytical conditions and we are therefore looking at ultratrace amounts. This extra sensitivity provides the capability of detecting components which interfere in the method and which are not normally detected. It also makes the mass spectra more difficult to interpret because of the small amount of component present in the sample and the certainty of identification is therefore reduced.

The mass spectrometric response can be used for quantitative purposes as well as qualitative interpretation. This quantitation, however, is accurate only when authentic standards of the components identified can be analysed through the total analytical process. As described above there are difficulties in obtaining many of these compounds. In the analysis of volatile organics the number of compounds which can be detected is more limited and consequently standards for a group of 23 volatile organics are routinely analysed for quantitative purposes. In the analysis of extractable organics the range of compounds to be considered is very extensive and a different, qualitative approach is taken. An estimate of the quantity of a component present in a sample can be made based on the response (ion current) of the compound compared to that of the internal standard. Some basic assumptions have to be made, which render the quantitation, an estimate. The main assumptions made are:

(i) The recovery of the compound in the concentration process is identical to that of the internal standard.

(ii) The mass spectrometric response of the compound is identical to that of the internal standard.

(iii) The GC/MS response is linear with concentration.

These assumptions may not be valid so only a semi-quantitative figure can be given.

The "Master Scheme for the Analysis of Organic Compounds in Water - Interim Protocols" suggests a detection limit of 5 ppb or 2 ppb (depending on technique) for extractable organics in surface waters. In the approach used for this study an attempt has been made to improve sensitivity to less than 0.5 ppb in order to characterise these samples.

5) Other class-specific scans were included for 7 chlorophenoxy acid herbicides, 8 triazine herbicides, 14 chlorinated benzenes and related compounds, 6 chlorophenols, tetrachlorodibenzo-p-dioxins (private wells only), 11 trialky-triaryl-phosphates and 13 organophosphate pesticides.

B. ANALYTICAL RESULTS - BACKGROUND WELL AT BALLANTRAE PLAZA

1) Priority Pollutant Scan

This scan (Table 10) did not detect the presence of any of the 80 compounds listed below or indicate the presence of unknown components in the well water. The detection limits for these compounds generally ranged from 0.5 - 5 ug/L.

Volatiles

1. 1,1-Dichloroethylene
2. Dichloromethane
3. t-1,2-Dichloroethylene
4. 1,1-Dichloroethane
5. Chloroform
6. 1,1,1-Trichloroethane
7. 1,2-Dichloroethane
8. Carbon tetrachloride
9. Benzene
10. 1,2-Dichloropropane
11. Trichloroethylene
12. Bromodichloromethane
13. Toluene
14. 1,1,2-Trichloroethane
15. Dibromochloromethane
16. Tetrachloroethylene
17. Chlorobenzene
18. Ethylbenzene
19. m + p-Xylene
20. Bromoform
21. o-Xylene
22. 1,1,2,2-Tetrachloroethane
23. 1,4-Dichlorobenzene
24. 1,3-Dichlorobenzene
25. 1,2-Dichlorobenzene

Acids

69. Hexadecanoic Acid
70. Phenol
71. 2-Nitrophenol
72. 4-Nitrophenol
73. 2,4-Dinitrophenol
74. 4,6-Dinitro-o-Cresol
75. p-Chloro-m-Cresol
76. 2-Chlorophenol
77. 2,4-Dichlorophenol
78. 2,4,6-Trichlorophenol
79. 2,4-Dimethylphenol
80. Pentachlorophenol

Base/Neutrals

26. Hexachloroethane
27. Hexachlorobutadiene
28. Hexachlorobenzene
29. 1,2,4-Trichlorobenzene
30. Bis-(2-chloroethoxy)methane
31. Naphthalene
32. 2-Chloronaphthalene
33. Nitrobenzene
34. 2,4-Dinitrotoluene
35. 2,6-Dinitrotoluene
36. 4-Bromophenyl phenyl ether
37. Bis-(2-Ethylhexyl) phthalate
38. Di-n-octyl phthalate
39. Di-methyl phthalate
40. Di-ethyl phthalate
41. Di-n-butyl phthalate
42. Butyl benzyl phthalate
43. Acenaphthylene
44. Acenaphthene
45. Fluorene
46. Fluoranthene
47. Chrysene
48. Pyrene
49. Phenanthrene
50. Anthracene
51. Benzo(a)anthracene
52. Dibenzo(a,h)anthracene
53. Benzo(b)fluoranthene
54. Benzo(a)pyrene
55. Benzo(g,h,i)perylene
56. 4-Chlorophenyl phenyl ether
57. 1,2-Diphenyl hydrazine
58. Hexachlorocyclopentadiene
59. N-Nitroso-diphenylamine
60. N-Nitroso-dimethylamine
61. N-Nitroso-di-n-Propylamine
62. Caffeine
63. Nitrobenzene
64. Butoxyethoxyethanol
65. Cholesterol
66. p-Chloroaniline
67. Benzothiazole
68. Benzo(k)fluoranthene

A scan for PCBs and 21 organochlorine pesticides (Table 6) was also negative. This scan includes the following compounds with detection limits between 1-5 ppt (ng/L) except for PCBs (20 ppt):

Organochlorine Pesticides

1. Hexachlorobenzene
2. Alpha BHC
3. Beta BHC
4. Gamma BHC (Lindane)
5. Heptachlor
6. Heptachlor Epoxide
7. Aldrin
8. Dieldrin
9. Endrin
10. Alpha Chlordane
11. Gamma Chlordane
12. pp'DDE
13. pp'DDD
14. op'DDT
15. pp'DDT
16. Methoxy Chlor (DMDT)
17. Mirex
18. Thiodan I
19. Thiodan II
20. Thiodan Sulphate
21. Oxychlordane
22. PCBs

The scan for the following trace metals is included in the priority pollutant scan.

Metal	Concentration (mg/L)	Detection Limit (mg/L#)
Arsenic	nd	0.001
Cadmium	nd	0.0001
Chromium	0.002	0.001
Copper	0.033	0.001
Lead	0.005	0.002
Mercury	nd	0.01
Nickel	0.002	0.001
Zinc	0.020	0.001

# except for mercury (ug/L)

The results are well within the Ministry's criteria for drinking water and are comparable to results from other drinking waters in the province. Data on general water quality parameters, microbiological analyses and levels of metals are included in Tables 2 to 4.

2) Volatile Organohalide Scan

This scan is calibrated for measuring chloroform, carbon tetrachloride, trichloroethylene, dichlorobromomethane, tetrachloroethylene and dibromochloromethane, with detection limits of 0.1-2 ug/L, and did not show the presence of any of the listed compounds (Table 9).

3) Gas Chromatographic/Mass Spectrometric Scan for Volatile Organics

All the compounds listed below are specifically quantitated in this scan. In addition, many other compounds in this class would be identified by GC/MS if they were present.

Volatile Organics

1. Methylene chloride
2. 1,1-Dichloroethane
3. Chloroform
4. 1,2-Dichloroethane
5. 1,1,1-Trichloroethane
6. Carbon tetrachloride
7. Dichlorobromomethane
8. 1,2-Dichloropropane
9. Trichloroethylene
10. Chlorodibromomethane
11. Benzene
12. 1,3-Dichlorobutane#
13. Bromoform
14. Tetrachloroethylene
15. Toluene
16. Chlorobenzene
17. Ethylbenzene
18. m-Xylene
19. o- or p-Xylene
20. 1,1-Dichloroethylene
21. 1,1,2-Trichloroethane
22. 1,1,2,2-Tetrachloroethane
23. 1,2-Dichlorobenzene
24. p-Chlorotrifluorotoluene

# internal standard

This scan, with detection limits of 0.05 ug/L for all 24 components except methylene chloride (5 ug/L), identified no components at concentrations greater than 1 ug/L. A number of components were detected at sub-ppb levels. These are:

Compound	Concentration (ug/L)
1,1,1-Trichloroethane	0.1
Toluene	0.4
Ethylbenzene	0.2
m-Xylene	0.3
o- or p-Xylene	0.3
Chloroform	below 0.05
Methyl isobutyl ketone	0.1#
a C_3 alkylbenzene	0.1#

# estimated concentrations, standards not analysed

4) Gas Chromatographic/Mass Spectrometric Analysis for Extractable Organics

This was carried out with both base-neutral and acid extracts with the following results:

Only three compounds were identified at levels estimated at about 1 ug/L (ppb). These were a gallic acid derivative (trimethoxybenzene), an unidentified component which was possibly an aliphatic hydrocarbon and a thioacetic acid derivative. The first compound could be of plant origin, possibly from natural tannins and lignins. The latter compound together with a similar compound seen at lower concentrations could be produced by sulphate-reducing bacteria or associated micro-organisms.

Partly because of a five-fold increase in analytical sensitivity employed for these samples, a range of organic compounds were observed at levels estimated at below the 1 ug/L concentration, many below the 0.1 ug/L levels. At these ultra-trace levels absolute identification of unknown individual organics becomes increasingly difficult.

Many of the ultra-trace organics found in the Ballantrae Plaza well can come from natural sources or as a result of human habitation.

The range of compounds found at an estimated concentration below the 1 ppb level were characterised as:

esters of fatty acids
alcohols
aliphatic aldehydes and alicyclic alcohols
caffeine derivatives
aldehydes and ketones

A number of compounds were tentatively identified at sub-ppb levels and could not be directly associated with natural sources. Due to the low concentrations, good mass spectra could not be obtained and positive identification was not possible. These compounds are:

Benzopyrene
Polycyclic aromatic ketones (2)
Dibenzyl
Naphthylamine
Amide derivatives (2)
Resorcyl aldehyde derivative

5) Other Class-Specific Scans

Results from other class-specific scans for trace organics are presented in Tables 6 to 9. These scans, comprising 60 compounds, were negative.

C. ANALYTICAL RESULTS - HUTCHINSON WELL

The analytical scheme applied in testing the Ballantrae Plaza well was also used for the Hutchinson well. For details see pages 15 to 17.

1) Priority Pollutant Scan

The priority pollutant scan (Table 11) did not detect the presence of any of the 80 compounds listed at the specified detection limits or indicate the presence of unknown compounds in the well water.

A scan for PCBs and 21 organochlorine pesticides was also negative (for list see Table 5).

Trace metals were detected at levels well below the Ministry's criteria and at levels expected in drinking water in the province. Data on general water quality parameters, microbiological analyses and levels of metals are included in Tables 2 to 4.

2) Volatile Organohalide Scan

This scan did not show the presence of any of the listed compounds (Table 9).

3) Gas Chromatographic/Mass Spectrometric Scan for Volatile Organics

The list of organics quantitated in this scan is shown on page 17. This scan with detection limits of 0.05 ug/L for all 24 components except methylene chloride (5 ug/L) identified no components at concentrations greater than 1 ug/L. The following compounds were identified at sub-ppb levels:

Compound	Concentration (ug/L)
Chloroform	0.1
Toluene	0.2
Ethylbenzene	below 0.1
m-Xylene	below 0.1
o + p-Xylene	below 0.1
Diethyl ether	below 0.1#

# estimated concentration, standard not analysed

4) Gas Chromatographic/Mass Spectrometric Analysis for Extractable Organics

This analysis was carried out on both base-neutral and acid extracts on a 1 litre sample. After correcting for laboratory background levels, an aliphatic alcohol was detected at an estimated level of 1 ug/L, with a second alcohol present at between 0.5 and 1 ug/L.

The five-fold increase in analytical sensitivity achieved in the analysis of this sample enabled a range of compounds to be identified or characterised at sub-ppb levels. Many of these compounds such as the alcohols mentioned above could be derived from natural sources and human habitation. At these ultratrace levels it becomes increasingly difficult to identify an individual organic component on the basis of its mass spectrum but it is often possible to assign a compound to a specific chemical class.

The range of compounds at below 1 ppb levels in the Hutchinson well were characterised as:

steroids
aliphatic alcohols
aliphatic hydrocarbons
aliphatic ketones and aldehydes
food preservatives

5) Other Class-Specific Scans

Results from other class-specific scans for trace organics are presented in Tables 6 to 9. These scans, comprising 60 compounds, were negative with the exception of the detection of an ester of phosphoric acid, tri(dichloropropyl) phosphate (Table 8). This chloroalkyl phosphate has been used in the past as a flame retardant in mattresses and other household items.

In an attempt to confirm this finding and to increase the sensitivity, a separate 4 litre water sample (usual volume is 1 litre) was extracted under neutral conditions. This extract was also subjected to GC/MS analysis for organic extractables. As before, but in greater number, similar classes of compounds were observed. The presence of tri(dichloropropyl) phosphate was confirmed, again at sub-ppb levels.

During the concentration procedures carried out for the Ames testing, extra resin cartridge concentrates were collected from this well. One of these XAD resin cartridges containing the organics trapped from 20L of water was eluted with methylene chloride to remove the organics, and the eluent was then concentrated. This procedure resulted in an extract concentrated 200,000-fold which was also analysed. This sampling technique, being based on a totally different principle of concentration, was considered to be confirmatory to our usual extraction procedures. The technique however has been optimised for the Ames test and blanks are considered clean when a negative Ames test is obtained. This does not necessarily mean that the cleaning procedure is adequate for GC/MS. It was in fact discovered that the blank contained a large number of organic components at the ultra-trace levels determined by the GC/MS analysis used. A full interpretation of the 20L extract is not yet available. Preliminary results, however, indicate the presence of compounds at a comparable concentration to those estimated in the 1L and 4L extracts. These include tri(dichloropropyl)phosphate; cholesterol and another steroid.

D. ANALYTICAL RESULTS - OBSERVATION WELLS

The analysis of observation wells, and the identification of organic substances present there, is useful in the evaluation of on-site aquifer contamination and in establishing possible contamination of private wells by chemicals of landfill site origin.

The three wells, OW 2-75, OW 16-70 and OW 1-80, were selected to develop a profile of chemical substances which might migrate from the site (OW 1-80) toward the Hutchinson well (close to OW 2-75) in a southwesterly direction.

During the sampling of these observation wells for trace organics, the field samplers inadvertently used organic solvents (hexane/acetone) when cleaning sampling equipment between the sampling of different wells. As the GC/MS analysis is optimised for trace levels of volatile organics, these components became major contaminants in the sample. One of the scientists accompanied the samplers on one occasion and determined the cause of the contamination. The following preliminary results have therefore ignored the presence of acetone and hexane isomers in the samples in order to allow the proper interpretation of GC/MS data.

The interpretation and linking of the data on extractable organics from the three wells showed different profiles for the observation wells but also a number of phosphate esters, phthalate esters and benzamide derivatives which were common to all observation wells. An investigation of the potential source of these compounds resulted in the analysis of a leachate of the gloves used during the sampling (which took place during the winter months). The above organic compounds were found to be leached from the gloves and have been omitted from the analytical results (see Table 18). The phosphate esters observed were different from the one found in the Hutchinson well.

The chromatographic priority pollutant screening was not found suitable because of the complexity of mixtures of organics in these wells. They were analysed by the more sophisticated Gas Chromatography/Mass Spectrometry (GC/MS) technique for volatile and extractable organics, and were also analysed for PCBs and trace metals.

1) Observation Well OW 2-75

PCBs, Organochlorine Pesticides and other Class-Specific Scans

The observation well water was tested for PCBs and 21 organochlorine pesticides as detailed on page 16, and none was detected (Table 15). Other class-specific scans were included as described on page 14 with the exception of analysis for tetrachlorodibenzo-p-dioxins. (At present the analytical method available for this class of compounds is only suitable for drinking water samples.) The only trace organic detected in OW 2-75 by these scans was pentachlorophenol, which was present at 0.06 ppb in the unfiltered sample and 0.1 ppb in the filtered sample (Tables 14 to 18).

Scan for Trace Metals (filtered)

Metals	Concentration mg/L	Detection Limit mg/L
Arsenic	nd	0.001
Cadmium	0.002	0.0002
Chromium	0.004	0.001
Copper	0.045	0.001
Lead	0.004	0.003
Nickel	0.006	0.001
Zinc	0.12	0.001

Data on general water quality parameters and levels for other metals are included in Tables 12 and 13.

GC/MS Scan for Volatile Organics

The list of organics for which the scan is normally calibrated is shown on page 17. This well contained only two volatile organics above the 1 ug/L level: isopropyl alcohol at 2.8 ug/L and methylethyl ketone at 1.2 ug/L.

A number of organics were identified at sub-ppb levels:

Compound	Concentration ug/L
Chloroform	0.1
Benzene	below 0.1
Toluene	0.1
*Diethyl ether	0.8#
*Tetrahydrofuran	0.2#
*Methyl-isobutyl ketone	0.6#
*Methylpentanol	0.2#
*Naphthalene	0.2#

# estimated concentrations, standards not analysed

* identifies bulk industrial organics of wide application

GC/MS Scan For Extractable Organics

No organic compound was found at levels above 1 ug/L. At sub-ppb levels, the following were identified or characterised:

0.5 - 1.0 ug/L:	* Octanoic acid
0.1 - 0.5 ug/L:	Molecular sulphur
below 0.1 ug/L:	Aromatic carboxylic acids (5)
	Unidentified carboxylic acids (3)
	* 4-Butoxybutyric acid
	Cyclohexenecarboxylic acid derivative
	Unidentified alcohols (2)
	Dimethyloctenol
	Aliphatic and alicyclic hydrocarbons (12)
	* Pentachlorophenol
	Unidentified (2)
	Methyl esters (2)
	* Butyl cellosolve methyl ether
	* Ethyl cellosolve
	Other cellosolve derivatives (3)
	Pentaoxapentadecane

* identifies bulk industrial organics of wide application

2) Observation Well OW 16-70

PCBs, Organochlorine Pesticides and other Class-Specific Scans

From the class-specific scans for trace organics (Tables 14 to 18), the following compounds were detected:

Compound	Filtered Sample	Unfiltered Sample
Beta BHC	2 ng/L	4 ng/L
Gamma BHC	nd	1 ng/L
PCBs	nd	25 ng/L
Pentachlorophenol	0.3 ug/L	0.2 ug/L

Scan for Trace Metals (filtered)

Metals	Concentration mg/L	Detection Limit mg/L
Arsenic	nd	0.001
Cadmium	0.003	0.0002
Chromium	0.004	0.001
Copper	0.031	0.001
Lead	0.010	0.003
Nickel	0.006	0.001
Zinc	0.16	0.001

Data on general water quality parameters and levels of other metals are included in Tables 12 and 13.

GC/MS Analysis for Volatile Organics

This well contained only one volatile organic compound above the 1 ppb level:

Toluene	1.4 ug/L

A number of other organics were identified at sub-ppb levels:

Compound	Concentration ug/L
Chloroform	below 0.1
Isopropanol	0.6#
Diethyl ether	0.6#
Aliphatic hydrocarbons (4)	0.1 - 0.3#

# estimated concentrations, standards not analysed

GC/MS Analysis For Extractable Organics

Compounds characterized or identified at above ppb levels:

Aliphatic hydrocarbons (16 at 1-3 ug/L individual concentrations)
Carboxylic acids (2 at 2 ug/L)
*Di-secondary butyl azelaate (4 ug/L)
Steroid (1 ug/L)

At 0.5 - 1.0 ppb levels:

Aliphatic hydrocarbons (13)
#Dimethylphenanthrene
#Condensed-ring aromatic hydrocarbon (M.W. 202)
Aliphatic alcohol
Aliphatic methyl ester
* Benzyl-butyl-phthalate
6-Acetyl-2,5-dihydroxy-1,4-naphthoquinone
Steroid

At 0.25 - 0.5 ppb levels:

Aliphatic hydrocarbons (11)
#Benzo(k)fluoranthene (or isomer)
#Methylphenanthrene (2 isomers)
Dodecyl-perhydro phenanthrene
Steroid
Alcohols (3)
* Butylated hydroxytoluene (BHT)
#Methyldibenzothiophene
Sulphur containing (possibly Pentathiepane)

At 0.1 - 0.25 ppb levels:

Aliphatic hydrocarbons (10)
#Methylphenanthrene
#1,6-Dimethyl-4-isopropylnaphthalene
#Dimethyl-isopropyl-decahydronaphthalene
Steroid
Cholestane
Cholesta-3,5-dien-7-one
Cholesta-3,5-diene
Alcohols (4)
Carboxylic acid
* Butyl stearate
* N-Methylbenzamide

Below 0.1 ppb:

Aliphatic hydrocarbons (36)
Aliphatic ketone
#7H-Indeno-2,1-anthracen-7-one
#2,5-Diacetyl-6-methoxybenzofuran
* Methyl palmitate
Methyl ester of carboxylic acid
* Butyl butyrate
* Isopropyl benzoate
Compound containing 1 chlorine atom (M.W. 304)

* identifies bulk industrial organics of wide application
# indicates coal tar or spent crank-case oil origin

3) Observation Well OW 1-80

PCBs, Organochlorine Pesticides and other Class-Specific Scans

As for the other observation wells, OW 1-80 was analysed for trace organics by class-specific scans (Tables 14 to 18). Only pentachlorophenol was detected at 4.4 ppb in the unfiltered sample and 3.4 ppb in the filtered sample.

Scan for Trace Metals (filtered)

Metals	Concentration (mg/L)	Detection Limit (mg/L)
Arsenic	0.001	0.001
Cadmium	0.0004 (unfilt.)	0.0002
Chromium	0.010	0.001
Copper	0.018	0.001
Lead	nd	0.003
Nickel	0.032	0.001
Zinc	0.33	0.001

Data on general water quality parameters and levels for other metals and extractable organics are included in Tables 12 and 13.

GC/MS Scan for Volatile Organics

The following compounds were identified:

Compound	Concentration (ug/L)
*1,1-Dichloroethane	2.1
*Chloroform	0.1
*1,2-Dichloroethane	0.7
Trichloroethylene	0.2
Benzene	1.4
Toluene	0.9
Ethylbenzene	present, not quantitated
o- + p-Xylenes	2.6
*trans-1,2-Dichloroethylene	2.0
*Diethyl ether	3.7#
*Methyl ethyl ketone	0.4#
Hydrocarbons C_7H_{16} isomers (4), total	5.8#
Hydrocarbons C_9H_{12} isomers (2), total	5.5#
Hydrocarbon $C_{10}H_{20}$ isomer	81.9#
*Methylstyrene	1.1#

# estimated concentrations, standards not analysed
* identifies bulk industrial organics of wide application

GC/MS Scan for Extractable Organics

The following compounds were identified or characterised at concentrations of 10 ppb or greater:

Compound	Estimated Concentration (ug/L)
* Dihydroisophorone	200
* Isophorone	22
* Isophorone isomer	40
* Menthol	17
* Carvomenthol	13
* Isopropyl benzoate	15
* Diethylpentylphosphate	40
Methyl esters of substituted cyclohexene-1-carboxylic acids (2)	40 + 12
* Pentachlorophenol	30
* Xylenol	30
* Ethylcarbitol ethyl ether	50
* Polyethyleneglycol derivatives	150
* Toluenesulphonamide	50
* Fenchone	25
Steroid	15
* 3-Methyl-2,6-dioxo-4-hexenoic acid	20
Aliphatic hydrocarbons (3), total	34
Polyglycol derivative	10
Unidentified	30
Molecular sulphur	10

At 1-9 ppb levels:

Compound	Estimated Concentration (ug/L)
Octanedione	9
Tetrahydro-hexamethyl-s-indacene-1,7-dione	9
Aliphatic aldehydes and ketones (3), total	5
Dimethyloctalone	6
1-Benzoyl-1-sec. butylacetone	3
* Propyleneglycol	9
Resin acid	4
* 4-Butoxybutanoic acid	2
Aliphatic alcohols (2)	3 + 4
Aliphatic and alicyclic hydrocarbons (10), total	69
Ethyl ester of a C_5 carboxylic acid	2
* Camphor	8
4-Hydroxyoctalone	1
3-(3-Dimethylamino)-2-propenylidene-2(3H) benzofuranone	3
Unidentified aliphatic alcohol	1
Unidentified polyglycol derivatives (2), total	11
Unidentified component	1
2-Propenylbenzoate	2
* S-Methylthioanisoate	1

At 0.5 - 1 ppb levels:

6-Methyl-6-azobicyclo(3,2,1)octan-3-one
Dimethylphthalic anhydride
Unidentified aldehyde/ketone
Propenylidene-2(3H)-benzofuranone-cyclohexanone derivative
Dimethylbenzoic acid
*p-t-Butylbenzoic acid
Alicyclic hydrocarbon
Methyl ester of carboxylic acid
Unidentified glycol derivatives (3)
2-Hexyl-1 methyl-Pyrrolidine
*Toluenesulphonamide

At 0.1 - 0.4 ppb levels:

*Phthalic anhydride
Unidentified aldehyde/ketone
*5-Ethyl-dihydro-5-phenyl-4,6(1H, 5H)pyrimidinedione (Primidone)
4-(1-hydroxy-1-isopropyl)acetophenone
Carboxylic acid (octanoic)
Aromatic carboxylic acids (3)
Unidentified alcohol
Aliphatic and alicyclic hydrocarbons (9)
Unidentified esters of carboxylic acids (4)
Unidentified glycol

* identifies bulk industrial organics of wide application

E. DISCUSSION

1) Organic Compounds

The Chemical Abstracts Service which maintains a registry of organic compounds, synthetic or identified natural products, has now over four million organics registered. Many of these are rare and exotic substances but thousands of synthetic organics are produced in multimillion (often billion) kilogram quantities. Numerous organics are in general industrial and household use. Because of their widespread application, a large number of man-made organic substances enter the ecosystem as contaminants of air, soil and water.

2) Priority Pollutants

Analysis for millions of organic compounds is clearly an impossible task. In order to develop a workable system, environmental scientists throughout the world felt the need for a selective process by which the formidable number of organic compounds could be reduced to an analytically manageable range. The selection process was guided by considerations regarding human and environmental toxicity, level of production and usage (tonnage), environmental mobility, persistence (stability, biodegrability) and bioaccumulation.

The Priority Pollutant Scan was designed to cover the most environmentally significant contaminants. Detection limits are generally well below levels of environmental or human health significance. This scan also includes a number of widely occurring innocuous substances to assist in data interpretation.

The gas chromatographic/mass spectrometric scans will show the presence of an extremely wide range of contaminants including those listed as priority pollutants and other compounds present down to sub-ppb levels. This technique can make a positive identification or characterisation of most contaminants even at these ultra-trace concentrations.

3) Chemicals at parts per billion (ppb) levels

It is very difficult to comprehend the sensitivity of modern trace analytical techniques. It is important to note that the numbers in many cases are more representative of detection limits and are not related to the degree of hazard. The ultra-trace concentrations reported must be viewed with this perspective in mind.

Considering a chemical substance (with a specific gravity the same as that of water), a concentration of 1 ppb (1 ug/L) in drinking water means that there is approximately 1 drop of this substance in 25,000 litres of water. A person drinking this water at the average consumption of 2 L/day would be exposed to two drops of this chemical in 68 years.

4) Ballantrae Plaza and Hutchinson Wells - General Water Quality Parameters

Detailed results from these two wells are presented in Table 2. The following is a general characterisation and evaluation of the standard water quality parameters. The water quality parameters shown for the Ballantrae Plaza and the Hutchinson wells are representative of much of the groundwater in southern Ontario, and unless otherwise indicated, are below Ontario drinking water quality criteria.

The waters would be considered very hard but this is common in areas with thick topsoil and limestone formations. In fact, groundwaters in Southern Ontario may reach levels of greater than 1000 mg/L hardness as calcium carbonate. Naturally soft waters are usually located only in the Canadian Shield area of Ontario. Calcium and magnesium are the cations generally responsible for the hardness of water and thus their levels vary widely with the hardness.

Alkalinity is often referred to as temporary hardness; that is, the scale which forms when water is boiled. Most Southern Ontario water is scale producing as opposed to the corrosivity of some soft acid waters in the north.

The level of iron in the Hutchinson well was below the drinking water quality objective of 0.3 mg/L. The level of iron in the Ballantrae well is above this objective and could certainly be responsible for some taste and odour and staining problems, but is not a health hazard. There are many wells in Southern Ontario which exhibit levels of iron as high or higher than this.

The limit set for chloride in drinking water is 250 mg/L for taste reasons. Both these wells are far below this limit and, in fact, are lower than the water from Lake Ontario (30-35 mg/L). The levels measured (Ballantrae Plaza, 14 mg/L; Hutchinson, 28 mg/L) are considered to be above typical background levels (1 to 5 mg/L) for the area.

Both the pH and conductivity fall within the normal range for groundwaters in Southern Ontario.

The sodium concentrations fall on the low side of the normal range. The recommended limit for those on a "totally" salt free diet has been set at 2 litres of water per day containing no more than 20 mg/L of sodium.

There is no limit for potassium since it is non toxic and rarely exceeds 20 mg/L in groundwaters.

Dissolved organic carbon is commonly due to the presence of naturally occurring organic matter. Values greater than 5 mg/L may be associated with colour, taste and odour problems.

The dissolved inorganic carbon is associated with the carbonate carbon and is normally approximately one quarter of the alkalinity concentration.

The maximum acceptable level of phenols is 2 ppb and is based on aesthetic considerations. While not normally present in well waters, they may originate from contaminated surface water which gains entry to a well through a faulty sanitary seal and may also result from the breakdown of humic materials. The presence of leachable phenolics would give ample warning of impending contamination by more toxic organic components such as PCBs which are not readily transported through soil by water.

Levels of sulphate greater than 250 mg/L may have cathartic effects on those consuming the water. Groundwaters in Southern Ontario vary from less than 1 mg/L sulphate to over 1000 mg/L sulphate.

The chemical oxygen demand is an indication of the oxygen equivalent of the inorganic and organic matter of a sample. Generally all wells used for drinking purposes are less than 50 mg/L COD.

Nitrite and nitrate concentrations are of concern if the water is to be consumed by an infant (under 7 months of age). High levels may lead to methemoglobinemia. No cases have been reported in areas where the total nitrite and nitrate concentration is less than 10 mg/L as N. Extremely high levels are sometimes associated with farm areas in which large amounts of chemical fertilizers are employed.

Levels of other water quality parameters tested in Hutchinson well water are listed under "Miscellaneous" in Table 8 and were below detection limits with the exception of volatile acids at 24 mg/L which is not considered significant in this test.

5) Bacteriological Assessment of the Ballantrae Plaza and Hutchinson Wells

The water from the Ballantrae Well contains no indicator bacteria representative of disease-causing bacteria. The heterotrophic plate count at 35°C is too low to be of any significance. No iron bacteria were present, but the low levels of sulphate-reducing bacteria may require treatment of the well by superchlorination at some future date to prevent odour and corrosion activity from occurring. No odour or sediment was present in the sample, which was slightly turbid. The higher level of sulphate-reducers after 20 hours indicates some proliferation of the bacteria within the aquifer.

The bacteria from the Hutchinson Well contains no indicator bacteria representative of disease-causing bacteria. The heterotrophic plate count at 35°C is too low to be of any significance. Some iron bacterial activity is present with the identification of some sheath material from the organism, Leptothrix. No sulphate-reducing bacteria were present after 26 days of incubation.

6) Trace Organics in the Ballantrae Plaza Well ("Background")

The Priority Pollutant Scan for organics did not detect any one of the compounds listed on page 2, although some were detected using the more sensitive gas chromatographic/mass spectrometric scan (purge and trap). The scan for organochlorine pesticides and PCBs with even lower detection limits showed the well water free of any pesticide or PCB contamination.

The number of aromatic hydrocarbons (alkylbenzenes) and aliphatic hydrocarbons indicated that this well sometime in the past may have been contaminated by petroleum hydrocarbons, most likely a gasoline spill. Petroleum hydrocarbons moving through soil into the aquifer will mobilize certain organics in the soil. Benzopyrene, some oxidized polycyclic aromatic compounds and naphthylamine were tentatively identified at the sub-ppb levels. Further testing will be undertaken to verify and fully characterise these compounds.

In general, the Ballantrae Plaza Well contained a larger number of organic compounds than the Hutchinson Well. The Ballantrae Well was chosen as a background well because there was a general agreement between Ministry personnel and Stouffville citizens that this well could not be affected by the York Sanitation landfill site.

7) Trace Organics in the Hutchinson Well

The Hutchinson Well was selected as the first landfill site adjacent drinking water source in the mutagenicity study. This choice was based on a preliminary finding of a single sample mutagenicity result by a university laboratory. While this well contained fewer organic compounds than the background well, it cannot be classified as purely domestic because of the business activities carried out on this location.

The alkylbenzenes, including toluene, found in the water at sub-ppb levels are widely found in surface and groundwaters. The major source of these contaminants is gasoline emissions and their widespread occurrence in the natural environment can be explained by atmospheric transport and precipitation. The aliphatic alcohols and ketones are naturally occurring and have industrial and domestic uses such as grease cutting solvents in detergent formulations and components of quick drying (spray) paints, respectively. At the trace levels detected, it is not possible to link these compounds with a specific source.

Diethyl ether was found in the Hutchinson well and in the three observation wells. The concentration in the Hutchinson well was less than 0.1 ug/L. Other compounds such as tetrahydrofuran and isopropyl alcohol were found only in the three observation wells. Diethyl ether would not be expected to selectively migrate in the ground water. It should also be noted that diethyl ether is the major component of starter-fluids (sprays) for diesel and gasoline engines and may be used at this location in connection with business activities. Solvents such as diethyl ether are also widely used in the laboratory and may have caused background levels in these samples.

A qualitatively important sub-ppb contaminant identified in the Hutchinson well was tri(dichloropropyl)phosphate. This is an industrial flame retardant which has been used in the treatment of household items, especially mattresses. Landfill site observation and leachate wells have been repeatedly analysed for the tri(dichloropropyl)phosphate but this particular compound was absent in every case. The selective transport of this compound is unlikely and because it was not detected in on-site wells, the tri(dichloropropyl)phosphate probably has a local origin.

8) Trace Organics in Observation Well OW 2-75

Only two organic compounds were identified at the low ppb level, isopropyl alcohol (2.8 ug/L) and methyl-ethyl ketone (1.2 ug/L).

At sub-ppb concentrations (0.1 - 0.8 ug/L) chloroform, benzene, toluene, diethyl ether, tetrahydrofuran, methylisobutyl ketone, methylpentanol and naphthalene were identified by the GC/MS scan for volatile organics.

Also at sub-ppb levels, the wood preservative pentachlorophenol was detected by class-specific scans.

OW 2-75 was the observation well closest to the Hutchinson property yielding sufficient quantity of water for analysis. In order to establish whether the trace organics present in the Hutchinson Well originated from the landfill site through aquifer contamination, the following chemical facts would have to be considered:

a) isopropyl alcohol, methyl ethyl ketone, diethyl ether, tetrahydrofuran should be the most readily mobilized chemicals owing to their high water solubility.

Of these four chemicals, only diethyl ether was found in the Hutchinson Well. Chemically it is most unlikely if not impossible that out of the four, only diethyl ether would reach the Hutchinson Well.

b) OW 2-75 contained only two light benzene derivatives, namely benzene and toluene near the detection limit (0.1 ug/L). The Hutchinson Well contained no benzene but did contain ethylbenzene and xylenes not found in the observation well.

c) GC/MS scan of extractables from OW 2-75 identified seven bulk industrial organics at the sub-ppb level. None of these were found to be present in the Hutchinson Well.

9) Trace Organics in Observation Well OW 16-70

This well showed the presence of two organochlorine pesticides and PCBs at the low ppt levels, pentachlorophenol at high ppt levels, toluene at 1.4 ppb and seven volatile organics at sub-ppb levels.

GC/MS analysis showed two well known bulk industrial organics at the low ppb levels and eight at sub-ppb levels. In addition, the well contained ten coal tar chemicals at sub-ppb levels. None of these showed up in OW 2-75 or the Hutchinson Well.

10) Trace Organics in Observation Well OW 1-80

This well is relatively shallow (20 ft.), situated in the central area of the landfill site and was shown to be most contaminated with industrial organics although no PCBs or organochlorine pesticides were detected in this study even at the low ppt levels. Pentachlorophenol was detected in both a filtered and unfiltered sample at low ppb levels.

Over one hundred organics were identified or characterized in OW 1-80. This information will be very useful in future monitoring for indicator trace organics.

In the GC/MS analyses pentachlorophenol is noted as being detected in relatively low concentrations. Table 17 for compound-specific analysis for chlorophenols shows different figures for pentachlorophenol concentrations. These latter figures should be taken as more accurate as the GC/MS quantitation is based on a non-chlorinated, non-phenolic calibration standard which probably has a significantly different response factor to pentachlorophenol.

VI CONCLUSIONS

The preliminary results on the chemical "fingerprinting" of the three observation wells and the chemical characterisation of leachate well 5, do not support the public perception concerning gross contamination of the groundwater quality in the area covered by the test wells.

The organic contents of the landfill site represent a potential hazard for future contamination, but based on the analytical data contained in this report, there is no indication that such contamination is occurring at the present time.

The increase in sensitivity attained by adjusting our standard methods for the analysis of organic components in the private wells has been able to pinpoint ultra-trace concentrations of a wide range of organics. No direct link has been established between the organics found in the three observation wells and the Hutchinson well.

In order to confirm the presence of a particular component in the water from the Hutchinson well, a resin concentrate of 20 L was utilised. The resin concentration technique as applied to the Ames test has been proven unreliable for general trace organic analysis of unknowns (due to the presence of impurities) but has been proven useful in this particular case for confirmation purposes.

The most toxic substances thus far discovered were PCBs which are not readily mobilized. No PCBs were detected in OW 2-75, OW 1-80 or in the Hutchinson or Ballantrae Plaza wells.

Over 90% of the organics in the leachate Well 5 sample consist of waste oils and petroleum hydrocarbons with a relatively high leachable phenol content. Thus, if organic contamination of neighbouring wells were to occur, this would probably manifest itself as a phenol nuisance problem well before contamination reached levels that could be classified as a significant health hazard.

Analytical data have shown that the observation wells generally contain low levels of trace metals. Furthermore, the pH of the groundwater on the landfill site is rather on the alkaline side, not conducive for the mobilization and transport of heavy metals.

Based on the existing federal and provincial drinking water quality criteria, the results of this study indicate that the Ballantrae Plaza and Hutchinson well waters are potable. Further testing will be carried out to ensure that the water quality continues to meet these criteria. The study to date has not established a link between the organics present in the on-site wells tested and the ultra-trace organics in the Hutchinson well.

VII APPENDICES

A. ANALYTICAL DATA TABLES

1. Leachate Well #5

Table 1

Headspace Analysis

Sample	Date Received	Volatile Organics (mg/L)																
		Pentane	2,2-Dimethylbutane	2,3-Dimethylbutane	3-Methylpentane	Hexane	2,4-Dimethylpentane	Cyclohexane	2,3-Dimethylpentane	3-Methylhexane	2,2,4-Trimethylpentane	Heptane	Benzene	Methylcyclohexane	2,3,4-Trimethylpentane	3-Methylheptane	Octane	Toluene
Leachate Well #5 (oil layer on liquid phase)	23/02/82	2.96	1.10	nd	6.03	37.6	9.34	nd	nd	23.0	nd	35.1	21.6	5.10	nd	13.1	8.90	328
Detection Limits		all 0.05 µg/L																

Sample	Date Received	Volatile Organics (mg/L)																								
		Nonane	Ethylbenzene	p-Xylene	m-Xylene	o-Xylene	Cumene	Styrene	Decane	n-Propylbenzene	o-Chlorotoluene	Mesitylene	p-Cymene	Undecane	m-Dichlorobenzene	Methylene Chloride	Carbon Tetrachloride	Chloroform	Trichloroethylene	Bromodichloromethane	Tetrachloroethylene	Chlorodibromomethane						
Leachate Well #5 (oil layer on liquid phase)	23/02/82	1.40	236	174	383	190	7.4	5.9	nd	nd	nd	nd	nd	nd	nd	0.53	0.03	0.01	0.30	nd	0.09	nd						
Detection Limits		all 0.05 µg/L																										

nd = non-detectable tr = trace (less than 0.1 µg/L) * = approximate results, response of standard not determined

Note: analysis by headspace technique, 85°C, 1 h

2. Ballantrae Plaza and Hutchinson Well

Table 2

		General Water Quality Parameters																				
											Nitrogen as N											
Sample	Date Received	Calcium (UR) mg/L	Magnesium (UR) mg/L	Hardness as $CaCO_3$ mg/L	Alkalinity as $CaCO_3$ mg/L	Iron as Fe (UT) mg/L	Chloride as Cl (UR) mg/L	pH µmho/cm	Conductivity (25°C) mg/L	Sodium as Na (UR) mg/L	Free Ammonia (FR) mg/L	Total Kjeldahl (UR) mg/L	Nitrite (FR) mg/L	Nitrate (FR) mg/L	Dissolved Organic Carbon (DOC) mg/L	Dissolved Inorganic Carbon (DIC) mg/L	Phenol µg/L	Chemical Oxygen Demand (COD) as O mg/L	Manganese as Mn(UR) mg/L	Sulphate as SO_4 (UR) mg/L	Potassium as K (UR) mg/L	Fluoride as F (UR) mg/L
Ballantrae Plaza	26/01/82	74 (67UT)	12 (19UT)	237	167	.77 .85	14	7.99	470	4.5	nd	0.2	0.01	nd	0.8	39	2	10		61	1.4	
Hutchinson	9/02/82	125	20	393	297	.051 .01	28	7.39	720	5.0	nd	0.3	nd	0.1	2.8	80	nd	nd		63	1.3	
Detection Limits		0.8	0.2	0.8	1.5	0.01	1.6		2.4	0.5	0.1	0.1	0.01	0.1	0.4	0.6	1.0	6	0.002	2.2	0.5	0.1

nd = non-detectable U = unfiltered F = filtered R = reactive T = total (unless otherwise indicated)

Table 3

Microbiology

		Membrane Filtration					P-A	Nuisance Organisms					
								Iron Bacteria					
Sample	Date Received	Total Coliforms (TC) /100 mL	TC Background (BKG) /100 mL	Fecal Coliforms (FC) /100 mL	Fecal Streptococci (FS) /100 mL	Heterotrophic Bacteria (35^0C) (HB) /100 mL	Presence-Absence	Identification	Crenothrix	Sphaerotilus	Gallionella	Leptothrix	Sulphate Reducers
Ballantrae													
Plaza 4 hours	25/01/82	0	0			1	absent		-	-	-	-	+(10-99/100mL)
20 hours	26/01/82	0	0			3	absent		-	-	-	-	+(100-999/100mL)
Hutchinson													
0 hours	9/02/82	0	0			8	absent		-	-	-	+	-
20 hours	9/02/82	0	0			6	absent		-	-	-	+	-

nd = non-detectable

Table 4

Sample	Date Received	Metals Arsenic (As) mg/L	Antimony (Sb) mg/L	Molybdenum (Mo mg/L	Zinc (Zn) mg/L	Lead (Pb) mg/L	Cadmium (Cd) mg/L	Cobalt (Co) mg/L	Chromium (Cr) mg/L	Vanadium (V) mg/L	Aluminum (Al) mg/L	Beryllium (Be) mg/L	Copper (Cu) mg/L	Titanium (Ti) mg/L	Strontium (Sr) mg/L	Bismuth (Bi) mg/L	Barium (Ba) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Cyanide (CN) * mg/L	Thallium (Tl) mg/L	Silver (Ag) mg/L	Mercury (Hg) µg/L	Manganese (Mn) mg/L
Ballantrae Plaza	26/01/82	nd		.006	.020	.005	nd	.004	.002	.002	.042	nd	.033	nd	.089		.100	.002		nd	nd		nd	.026
Hutchinson	9/02/82			.006	.081	.007	.0003	.004	.004	.003	.080	nd	.066	nd	.081		.043	.003		nd	nd		.01	.019
Hutchinson	1/03/82	nd																						
Detection Limits		0.001		.001	.001	.002	.0001	.001	.001	.001	.001	.001	.001	.001	.001		.001	.001		.005	.002		.01	.001

nd = non-detectable * unfiltered, reactive

Detection limits indicated were the highest ones observed and were selected in order to provide data with the lowest possible determinate error. In some cases actual detection limits were lower than these values. All parameters are unfiltered, total unless otherwise indicated.

Table 5

Sample	Date Received	Organochlorine Pesticides																					
		Hexachlorobenzene ng/L	Alpha BHC ng/L	Beta BHC ng/L	Gamma BHC ng/L	Heptachlor ng/L	Heptachlor Epoxide ng/L	Aldrin ng/L	Dieldrin ng/L	Endrin ng/L	Alpha Chlordane ng/L	Gamma Chlordane ng/L	pp'DDE ng/L	pp'DDD ng/L	op'DDT ng/L	pp'DDT ng/L	Methoxy Chlor (DMDT) ng/L	Mirex ng/L	Thiodan I ng/L	Thiodan II ng/L	Thiodan Sulphate ng/L	Oxychlordane ng/L	PCB's ng/L
Ballantrae Plaza	26/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hutchinson	9/02/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		1	1	1	1	1	1	1	2	4	2	2	1	5	5	5	4	5	2	4	4	2	20

nd = non-detectable

Table 6

Sample	Date Received	Chlorophenoxy Acid Herbicides							Triazine Herbicides							
		Dicamba µg/L	2,4-DP µg/L	2,4-D µg/L	Silvex µg/L	2,4,5-T µg/L	2,4-DB µg/L	Picloram µg/L	Prometone µg/L	Propazine µg/L	Atrazine µg/L	Prometryne µg/L	Simazine µg/L	Ametryne µg/L	Sencor µg/L	Bladex µg/L
Ballantrae Plaza	26/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hutchinson	9/02/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		0.1	0.1	0.1	0.05	0.05	0.2	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1

nd = non-detectable

Table 7

Sample	Date Received	Chlorinated Benzenes (and Related Compounds)														Chlorophenols						TCDD's
		Hexachloroethane µg/L	1,2,5-Trichlorobenzene µg/L	1,2,4-Trichlorobenzene µg/L	1,2,3-Trichlorobenzene µg/L	Hexachlorobutadiene µg/L	2,4,5-Trichlorotoluene µg/L	2,3,6-Trichlorotuluene µg/L	1,2,4,5-Tetrachlorobenzene µg/L	1,2,3,5-Tetrachlorobenzene µg/L	2,6-alpha-Trichlorotoluene µg/L	1,2,3,4-Tetrachlorobenzene µg/L	Pentachlorobenzene µg/L	Hexachlorobenzene µg/L	Octachlorostyrene µg/L	2,4,6-Trichlorophenol µg/L	2,4,5-Trichlorophenol µg/L	2,3,4-Trichlorophenol µg/L	2,3,5,6-Tetrachlorophenol µg/L	2,3,4,5-Tetrachlorophenol µg/L	Pentachlorophenol µg/L	Tetrachlorodibenzo -p-dioxine ng/L
Ballantrae Plaza	26/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hutchinson	9/02/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.2

nd = non-detectable

Table 8

Sample	Date Received	Trialkyl-/arylphosphates: Tri(butyl)phosphate µg/L	Tri(2-chloroethyl) phosphate µg/L	Tri(dichloropropyl) phosphate µg/L	Tri(phenyl)phosphate µg/L	Tri(butoxyethyl) phosphate µg/L	o-Isopropylphenyl-diphenylphosphate µg/L	Tri(o-tolyl)phosphate µg/L	Tri(m-tolyl)phosphate µg/L	Tri(p-tolyl)phosphate µg/L	p-tertbutylphenyl-diphenylphosphate µg/L	Tri(2,4-xylyl)phosphate µg/L	Miscellaneous: Methylene blue active substances (LAS) mg/L	Total phosphorus mg/L	Dissolved reactive phosphorus mg/L	Phosphates (FR) mg/L	Volatile acids mg/L
Ballantrae Plaza	26/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd					
Hutchinson	9/02/82	nd	nd	+	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd	24
Detection Limits		This new methodology is still semi-quantitative. The single positive value (+) appears to be in the range 0.1-10 ppb. Method Development and Retesting is ongoing.											0.1	0.02		0.02	10

nd = non-detectable

Table 9

		Volatile Organohalides						Organophosphate Pesticides												
Sample	Date Received	Chloroform $CHCl_3$ µg/L	Carbon Tetrachloride CCl_4 µg/L	Trichloroethylene C_2HCl_3 µg/L	Dichlorobromomethane $CHCl_2Br$ µg/L	Tetrachloroethylene C_2Cl_4 µg/L	Dibromochloromethane $CHClBr_2$ µg/L	Dichlorvos µg/L	Thimet µg/L	Mevinphos µg/L	Diazinon µg/L	Ronnel µg/L	Parathion µg/L	Methyl Parathion µg/L	Malathion µg/L	Ethion µg/L	Methyl Trithion µg/L	Dursban µg/L	Reldan µg/L	Guthion µg/L
Ballantrae Plaza	26/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hutchinson	9/02/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		1	0.1	2	0.5	0.1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10	0.01	0.01	1.0

nd = non-detectable

Table 10

IMS - 491 Ballantrae Plaza 82/01/25

PRIORITY POLLUTANT SCAN FOR VOLATILES, ACID, BASE/NEUTRAL EXTRACTABLES, PESTICIDES PCB'S, METALS AND OTHER PARAMETERS

Volatiles	Concentration ug/L	Detection Limit
1. 1,1-Dichloroethylene	nd	1
2. Dichloromethane	nd	5
3. t-1,2-Dichloroethylene	nd	1
4. 1,1-Dichloroethane	nd	1
5. Chloroform	nd	1
6. 1,1,1-Trichloroethane	nd	1
7. 1,2-Dichloroethane	nd	1
8. Carbon Tetrachloride	nd	1
9. Benzene	nd	1
10. 1,2-Dichloropropane	nd	1
11. Trichloroethylene	nd	1
12. Bromodichloromethane	nd	1
13. Toluene	nd	1
14. 1,1,2-Trichloroethane	nd	1
15. Dibromochloromethane	nd	1
16. Tetrachloroethylene	nd	1
17. Chlorobenzene	nd	1
18. Ethyl Benzene	nd	1
19. m/p-xylene	nd	1
20. Bromoform	nd	1
21. o-xylene	nd	1
22. 1,1,2,2-Tetrachloroethane	nd	1
23. 1,4-Dichlorobenzene	nd	1
24. 1,3-Dichlorobenzene	nd	1
25. 1,2-Dichlorobenzene	nd	1
Base/Neutrals		
26. Hexachloroethane	nd	2
27. Hexachlorobutadiene	nd	2
28. Hexachlorobenzene	nd	2
29. 1,2,4-Trichlorobenzene	nd	1
30. Bis-(2-chloroethoxy)methane	nd	1
31. Naphthalene	nd	1
32. 2-Chloronaphthalene	nd	0.5
33. Nitrobenzene	nd	0.5
34. 2,4-Dinitrotoluene	nd	0.5
35. 2,6-Dinitrotoluene	nd	0.5
36. 4-Bromophenyl Phenyl Ether	nd	0.5
37. Bis-(2-Ethylhexyl) Phthalate	nd	1
38. Di-n-Octyl Phthalate	nd	0.5
39. Di-methyl Phthalate	nd	1
40. Di Ethyl Phthalate	nd	1
41. Di n-Butyl Phthalate	nd	1
42. Butyl Benzyl Phthalate	nd	1
43. Acenaphthylene	nd	0.5
44. Acenaphthene	nd	1
45. Fluorene	nd	1

Table 10 cont.

IMS - 491 Ballantrae Plaza 82/01/25

Volatiles	Concentration ug/L	Detection Limit
46. Fluoranthene	nd	1
47. Chrysene	nd	1
48. Pyrene	nd	1
49. Phenanthrene	nd	1
50. Anthracene	nd	1
51. Benzo(a)Anthracene	nd	1
52. Dibenzo(a,h)Anthracene	nd	6
53. Benzo(b)Fluoranthene	nd	1
54. Benzo(a)Pyrene	nd	1
55. Benzo(g,h,i)Perylene	nd	12
56. 4-Chlorophenyl Phenyl Ether	nd	
57. 1,2-Diphenyl Hydrazine	nd	1
58. Hexachlorocyclopentadiene	nd	2
59. N-Nitroso-Diphenylamine	nd	0.5
60. N-Nitroso-Dimethylamine	nd	0.5
61. N-Nitroso-Di-n-Propylamine	nd	0.5
62. Caffeine	nd	2
63. Nitrobenzene	nd	
64. Hexachlorocyclopentadiene	nd	2
65. Butoxyethoxyethanol	nd	1
66. Cholesterol	nd	10
67. p-Chloroaniline	nd	1
68. Benzothiazole	nd	0.5
69. Benzo(k)Fluoranthene	nd	6
Acids		
70. Hexadecanoic Acid	nd	6
71. Phenol	nd	1
72. 2-Nitrophenol	nd	3
73. 4-Nitrophenol	nd	6
74. 2,4-Dinitrophenol	nd	40
75. 4,6-Dinitro-o-Cresol	nd	6
76. p-Chloro-m-Cresol	nd	3
77. 2-Chloro Phenol	nd	1
78. 2,4-Dichlorophenol	nd	3
79. 2,4,6-Trichlorophenol	nd	3
80. 2,4-Dimethyl Phenol	nd	1
81. Pentachlorophenol	nd	6

Metals	Concentration mg/L	
Arsenic	to be run	
Cadmium	nd	0.0001
Chromium	0.002	0.0002
Copper	0.033	0.01
Lead	0.005	0.002
Mercury	nd	0.01 ug/L
Nickel	0.002	0.005
Selenium	not run	
Zinc	0.020	0.0001

Table 10 cont.

IMS - 491 Ballantrae Plaza 82/01/25

Pesticides PCB's	Concentration ng/L	Detection Limit
Arochlor 1016	nd	20
Arochlor 1221	nd	20
Arochlor 1242	nd	20
Arochlor 1248	nd	20
Arochlor 1254	nd	20
Arochlor 1260	nd	20
Hexachlorobenzene	nd	1
Heptachlor	nd	1
Aldrin	nd	1
4,4'-DDE	nd	1
Mirex	nd	5
Alpha BHC	nd	1
Beta BHC	nd	1
Gamma BHC (Lindane)	nd	1
Alpha Chlordane	nd	2
Gamma Chlordane	nd	2
Oxychlordane	nd	2
1,4'-DDT	nd	5
4,4'-DDD	nd	5
4,4'-DDT	nd	5
Methoxychlor (DMDT)	nd	4
Thiodan I	nd	2
Thiodan II	nd	4
Thiodan Sulfate	nd	4
Heptachlor Epoxide	nd	1
Dieldrin	nd	2
Endrin	nd	4

Other Parameters	Concentration mg/L	
Total Cyanide		
Free Cyanide	nd	0.005
Miscellaneous Total Phenols		

Table 11

IMS 502 - Hutchinson 82/02/08

PRIORITY POLLUTANT SCAN FOR VOLATILES, ACID, BASE/NEUTRAL EXTRACTABLES, PESTICIDES PCB'S, METALS AND OTHER PARAMETERS

Volatiles	Concentration ug/L	Detection Limit
1. 1,1-Dichloroethylene	nd	1
2. Dichloromethane	nd	5
3. t-1,2-Dichloroethylene	nd	1
4. 1,1-Dichloroethane	nd	1
5. Chloroform	nd	1
6. 1,1,1-Trichloroethane	nd	1
7. 1,2-Dichloroethane	nd	1
8. Carbon Tetrachloride	nd	1
9. Benzene	nd	1
10. 1,2-Dichloropropane	nd	1
11. Trichloroethylene	nd	1
12. Bromodichloromethane	nd	1
13. Toluene	nd	1
14. 1,1,2-Trichloroethane	nd	1
15. Dibromochloromethane	nd	1
16. Tetrachloroethylene	nd	1
17. Chlorobenzene	nd	1
18. Ethyl Benzene	nd	1
19. m/p-xylene	nd	1
20. Bromoform	nd	1
21. o-xylene	nd	1
22. 1,1,2,2-Tetrachloroethane	nd	1
23. 1,4-Dichlorobenzene	nd	1
24. 1,3-Dichlorobenzene	nd	1
25. 1,2-Dichlorobenzene	nd	1
Base/Neutrals		
26. Hexachloroethane	nd	2
27. Hexachlorobutadiene	nd	2
28. Hexachlorobenzene	nd	2
29. 1,2,4-Trichlorobenzene	nd	1
30. Bis-(2-chloroethoxy)methane	nd	1
31. Naphthalene	nd	1
32. 2-Chloronaphthalene	nd	0.5
33. Nitrobenzene	nd	0.5
34. 2,4-Dinitrotoluene	nd	0.5
35. 2,6-Dinitrotoluene	nd	0.5
36. 4-Bromophenyl Phenyl Ether	nd	0.5
37. Bis-(2-Ethylhexyl) Phthalate	nd	1
38. Di-n-Octyl Phthalate	nd	0.5
39. Di-methyl Phthalate	nd	1
40. Di Ethyl Phthalate	nd	1
41. Di n-Butyl Phthalate	nd	1
42. Butyl Benzyl Phthalate	nd	1
43. Acenaphthylene	nd	0.5
44. Acenaphthene	nd	1
45. Fluorene	nd	1

Table 11 cont.

IMS 502 - Hutchinson 82/02/08

Volatiles	Concentration ug/L	Detection Limit
46. Fluoranthene	nd	1
47. Chrysene	nd	1
48. Pyrene	nd	1
49. Phenanthrene	nd	1
50. Anthracene	nd	1
51. Benzo(a)Anthracene	nd	1
52. Dibenzo(a,h)Anthracene	nd	6
53. Benzo(b)Fluoranthene	nd	1
54. Benzo(a)Pyrene	nd	1
55. Benzo(g,h,i)Perylene	nd	12
56. 4-Chlorophenyl Phenyl Ether	nd	
57. 1,2-Diphenyl Hydrazine	nd	1
58. Hexachlorocyclopentadiene	nd	2
59. N-Nitroso-Diphenylamine	nd	0.5
60. N-Nitroso-Dimethylamine	nd	0.5
61. N-Nitroso-Di-n-Propylamine	nd	0.5
62. Caffeine	nd	2
63. Nitrobenzene	nd	
64. Hexachlorocyclopentadiene	nd	2
65. Butoxyethoxyethanol	nd	1
66. Cholesterol	nd	10
67. p-Chloroaniline	nd	1
68. Benzothiazole	nd	0.5
69. Benzo(k)Fluoranthene	nd	6
Acids		
70. Hexadecanoic Acid	nd	6
71. Phenol	nd	1
72. 2-Nitrophenol	nd	3
73. 4-Nitrophenol	nd	6
74. 2,4-Dinitrophenol	nd	40
75. 4,6-Dinitro-o-Cresol	nd	6
76. p-Chloro-m-Cresol	nd	3
77. 2-Chloro Phenol	nd	1
78. 2,4-Dichlorophenol	nd	3
79. 2,4,6-Trichlorophenol	nd	3
80. 2,4-Dimethyl Phenol	nd	1
81. Pentachlorophenol	nd	6
Metals	**Concentration mg/L**	
Arsenic		
Cadmium	0.003	0.0001
Chromium	0.004	0.0002
Copper	0.066	0.01
Lead	0.007	0.002
Mercury	nd	0.02 ug/L
Nickel	0.004	0.005
Selenium		
Zinc	0.081	0.0001

Table 11 cont.

IMS 502 - Hutchinson 82/02/08

Pesticides PCB's	Concentration ng/L	Detection Limit
Arochlor 1016	nd	20
Arochlor 1221	nd	20
Arochlor 1242	nd	20
Arochlor 1248	nd	20
Arochlor 1254	nd	20
Arochlor 1260	nd	20
Hexachlorobenzene	nd	1
Heptachlor	nd	1
Aldrin	nd	1
4,4'-DDE	nd	1
Mirex	nd	5
Alpha BHC	nd	1
Beta BHC	nd	1
Gamma BHC (Lindane)	nd	1
Alpha Chlordane	nd	2
Gamma Chlordane	nd	2
Oxychlordane	nd	2
1,4'-DDT	nd	5
4,4'-DDD	nd	5
4,4'-DDT	nd	5
Methoxychlor (DMDT)	nd	4
Thiodan I	nd	2
Thiodan II	nd	4
Thiodan Sulfate	nd	4
Heptachlor Epoxide	nd	1
Dieldrin	nd	2
Endrin	nd	4

Other Parameters	Concentration mg/L	
Total Cyanide		
Free Cyanide	nd	0.005
Miscellaneous Total Phenols		

3. Observation Wells

Table 12

Sample	Date Received	General Water Quality Parameters																				
											Nitrogen as N											
		Calcium (UR)	Magnesium (UR)	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$	Iron as Fe (UT)	Chloride as Cl (UR)	pH	Conductivity (25°C)	Sodium as Na (UR)	Free Ammonia (FR)	Total Kjeldahl (UR)	Nitrite (FR)	Nitrate (FR)	Dissolved Organic Carbon (DOC)	Dissolved Inorganic Carbon (DIC)	Phenol	Chemical Oxygen Demand (COD) as O	Manganese as Mn(UR)	Sulphate as SO_4 (UR)	Potassium as K (UR)	Fluoride as F (UR)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µmho/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L
OW 16-70	7/01/82	136	15	401	336	0.35	58	7.74	930	49.5	nd	0.4	0.01	0.4			2*	35		91	2.3	
OW 2-75		118	18	368	360	2.10	49	7.62	790	27.0	nd	0.4	0.01	nd			1*	40		3	1.4	
OW 1-80		206	30	652	628	12.00	104	7.28	1420	79.0	nd	1.0	0.01	nd	280.0	158.0	6*	140		15	2.6	
Detection Limits		0.8	0.2	0.8	1.5	0.01	1.6		2.4	0.5	0.1	0.1	0.01	0.1	0.4	0.6	1.0	4		2.2	0.5	0.1

nd = non-detectable U = unfiltered F = filtered R = reactive T = total (unless otherwise indicated) * sample not properly preserved

Table 13

Sample	Date Received	Metals																						
		Arsenic (As) mg/L	Antimony (Sb) mg/L	Molybdenum (Mo) mg/L	Zinc (Zn) mg/L	Lead (Pb) mg/L	Cadmium (Cd) mg/L	Cobalt (Co) mg/L	Chromium (Cr) mg/L	Vanadium (V) mg/L	Aluminum (Al) mg/L	Beryllium (Be) mg/L	Copper (Cu) mg/L	Titanium (Ti) mg/L	Strontium (Sr) mg/L	Bismuth (Bi) mg/L	Barium (Ba) mg/L	Nickel (Ni) mg/L	Selenium (Se) mg/L	Cyanide (CN) µg/L	Thallium (Tl) mg/L	Silver (Ag) mg/L	Mercury (Hg) µg/L	Manganese (Mn) mg/L
OW 16-70	19/11/81	.001		.008	.66	.24	.006	.037	.025	nd	.61	nd	2.6	.022			.17	.043						.26
OW 16-70 filt.		nd		.008	.16	.010	.003	.006	.004	nd	.088	nd	.031	nd			.042	.006						.065
OW 2-75	19/11/81	nd		.002	.34	.12		.026	.024	nd	.28	nd	1.0	.004			.18	.046						.15
OW 2-75 filt.		nd		.001	.12	.004	.002	.004	.004	.002	.10	nd	.045	nd			.090	.006						.059
OW 1-80*	23/11/81	.002		.014	24	.050	.0004	.054	.070	.044	21	.001	.24				.27	.077						1.4
OW 1-80 filt.		.001		.005	.33	nd		.020	.010	.020	.20	nd	.018	nd			.15	.032						1.0
Detection Limits		0.001		.001	.001	.003	.0002	.001	.001	.001	.001	.001	.001	.001			.001	.001						.001

nd = non-detectable   * Results are approximate, heterogeneous sample

Detection limits indicated were the highest ones observed and were selected in order to provide data with the lowest possible determinate error. In some cases actual detection limits were lower than these values. All parameters are unfiltered, total unless otherwise indicated. Not all data reported on LIS; part of multi-element scan.

Table 14

		Volatile Organohalides						Organophosphate Pesticides												
Sample	Date Received	Chloroform $CHCl_3$ µg/L	Carbon Tetrachloride CCl_4 µg/L	Trichloroethylene C_2HCl_3 µg/L	Dichlorobromomethane $CHCl_2Br$ µg/L	Tetrachloroethylene C_2Cl_4 µg/L	Dibromochloromethane $CHClBr_2$ µg/L	Dichlorvos µg/L	Thimet µg/L	Mevinphos µg/L	Diazinon µg/L	Ronnel µg/L	Parathion µg/L	Methyl Parathion µg/L	Malathion µg/L	Ethion µg/L	Methyl Trithion µg/L	Dursban µg/L	Reldan µg/L	Guthion µg/L
OW 16-70	7/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 2-75		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 1-80		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		1	0.1	2	0.5	0.1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10	0.01	0.01	1.0

nd = non-detectable

Table 15

Sample	Date Received	Organochlorine Pesticides																					
		Hexachlorobenzene ng/L	Alpha BHC ng/L	Beta BHC ng/L	Gamma BHC ng/L	Heptachlor ng/L	Heptachlor Epoxide ng/L	Aldrin ng/L	Dieldrin ng/L	Endrin ng/L	Alpha Chlordane ng/L	Gamma Chlordane ng/L	pp'DDE ng/L	pp'DDD ng/L	op'DDT ng/L	pp'DDT ng/L	Methoxy Chlor (DMDT) ng/L	Mirex ng/L	Thiodan I ng/L	Thiodan II ng/L	Thiodan Sulphate ng/L	Oxychlordane ng/L	PCB's ng/L
OW 16-70	7/01/82	nd	nd	4	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	25
OW 16-70 filt.		nd	nd	2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 2-75		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 2-75 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 1-80		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 1-80 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		1	1	1	1	1	1	1	2	4	2	2	1	5	5	5	4	5	2	4	4	2	20

nd = non-detectable

Table 16

Sample	Date Received	Chlorophenoxy Acid Herbicides							Triazine Herbicides							
		Dicamba µg/L	2,4-DP µg/L	2,4-D µg/L	Silvex µg/L	2,4,5-T µg/L	2,4-DB µg/L	Picloram µg/L	Prometone µg/L	Propazine µg/L	Atrazine µg/L	Prometryne µg/L	Simazine µg/L	Ametryne µg/L	Sencor µg/L	Bladex µg/L
OW 16-70	7/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 16-70 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 2-75		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 2-75 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 1-80		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
OW 1-80 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Detection Limits		0.1	0.1	0.1	0.05	0.05	0.2	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1

nd = non-detectable

Table 17

		Chlorinated Benzenes (and Related Compounds)														Chlorophenols						TCDD's
Sample	Date Received	Hexachloroethane µg/L	1,3,5-Trichlorobenzene µg/L	1,2,4-Trichlorobenzene µg/L	1,2,3-Trichlorobenzene µg/L	Hexachlorobutadiene µg/L	2,4,5-Trichlorotoluene µg/L	2,3,6-Trichlorotoluene µg/L	1,2,4,5-Tetrachlorobenzene µg/L	1,2,3,5-Tetrachlorobenzene µg/L	2,6-alpha-Trichlorotoluene µg/L	1,2,3,4-Tetrachlorobenzene µg/L	Pentachlorobenzene µg/L	Hexachlorobenzene µg/L	Octachlorostyrene µg/L	2,4,6-Trichlorophenol µg/L	2,4,5-Trichlorophenol µg/L	2,3,4-Trichlorophenol µg/L	2,3,5,6-Tetrachlorophenol µg/L	2,3,4,5-Tetrachlorophenol µg/L	Pentachlorophenol µg/L	Tetrachlorodibenzo -p-dioxins ng/L
OW 16-70	7/01/82	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.2	
OW 16-70 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.3	
OW 2-75		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	.06	
OW 2-75 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.1	
OW 1-80		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	4.4	
OW 1-80 filt.		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	3.4	
Detection Limits		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.05	0.1	0.05	0.05	0.05	0.2

nd = non-detectable

Table 18

Sample	Date Received	Trialkyl-/arylphosphates											Miscellaneous		
		Tri(butyl)phosphate µg/L	Tri(2-chloroethyl) phosphate µg/L	Tri(dichloropropyl) phosphate µg/L	Tri(phenyl)phosphate µg/L	Tri(butoxyethyl) phosphate µg/L	o-Isopropylphenyl-diphenylphosphate µg/L	Tri(o-tolyl)phosphate µg/L	Tri(m-tolyl)phosphate µg/L	Tri(p-tolyl)phosphate µg/L	p-tertbutylphenyl-diphenylphosphate µg/L	Tri(2,4-xylyl)phosphate µg/L	Methylene blue active substances (LAS) mg/L	Total phosphorus mg/L	Dissolved reactive phosphorus mg/L
OW 16-70	8/01/82	nd	nd	nd	*	nd	*	nd	nd	nd	nd	nd	nd	0.18	nd
OW 2-75		nd	nd	nd	*	nd	*	nd	nd	nd	nd	nd	nd	0.32	0.16
OW 1-80		nd	nd	nd	*	nd	*	*	*	nd	*	nd	2.75	9.6	0.02
Detection Limits		* See Page 22 - work is ongoing to remove interferences associated with sampling techniques.											0.1	0.02	0.02

nd = non-detectable

B. GC/MS ANALYSIS BY MANN TESTING LABORATORY ON BALLANTRAE PLAZA AND HUTCHINSON WELLS

MANN TESTING LABORATORIES LTD.,
80 GALAXY BLVD., UNIT 10,
REXDALE, ONTARIO
M9W 4Y8
PHONE: 675-3598
TELEX: 06-989502

March 3, 1982

M. Glenys Foster, M.Sc.
Chief, Mass Spectrometry Services
Organic Trace Contaminants Section
Laboratory Services Branch
Ministry of the Environment
P.O. Box 213
Rexdale, Ontario
M9W 5L1

Dear Ms Foster:

RE: Lab. No. 820107

Samples from Test Wells #1 and #2 were delivered to this laboratory by yourself on Friday, February 12, 1982 and analysed in accordance with your quality assurance protocols, a copy of which is attached. Ordinary tap water was used as a control. Deuterated internal standards were added to all samples including the control.

The analysis protocol followed closely the procedures established by the United States EPA. Three fractions of each samples were prepared and analysed by the GC/Mass Spectrometry--

1. Purge and trap fraction for volatiles
2. Base-neutral fraction
3. Acid fraction

The detection limit for all fractions was 1 ug/l or better. The GC/MS output was by the Finnigan Incos Data System based on the NBS library of approximately 31000 compounds. Manual examination was performed on all data output. The reports are attached for your persual.

In general the levels of contaminants were very low. Phthalates were determined at the 1 ppb level however they can not be attributed conclusively to the water sample. These substances (plasticizers) are very common and appear constantly in our extractions. Similarly methylene chloride was found by purge and trap methods at the 100 ppb level. Methylene chloride is our most common laboratory solvent. It generally appears in samples at the 20 ppb level with a 5 ml purge. It is conceivable that with the 25 ml purge, as used for these tests, that the 100 ppb level is not unexpected.

Due to the sensitivity of these samples we conducted additional work. The acid extracts were methylated with diazomethane and again analysed by GC/MS. Base-neutral and acid extracts were screened by GC through an OV-17 packed column and an electron capture detector. No additional information was obtained from these tests.

Resin acids were not detected in our extracts except for a trace of 1-phenanthrene carboxylic acid-octahydro-dimethyl.

The presence of toxic organic compounds would have been detected by our tests if they were in excess of 1 ug/l.

All data will be stored on the computer until March 30, 1982. Please let me know if you wish further information or require additional confirmatory testing.

Yours truly,

MANN TESTING LABORATORIES LTD.

John W. Martin,P.Eng.
Vice President

JWM/rc

Att.

ANALYTIC PROCEDURE REPORT

STOUFFVILLE SAMPLES & TAP WATER BLANKS

A) Purgeables/Volatiles

Twenty-five millilitres of water was spiked with 100 nanograms of deuterated chlorobenzene, (C_6D_5Cl) to 4 ppb. The mixture was then sparged for 20 minutes on the concentrator. The concentrate was then back flushed onto a 50 metre Carbowax 20 M capillary column and the eluants analysed by mass spectrometry. A Finnigan 3200 MS was used in conjunction with the Incos Data system of the Finnigan 4023 MS.

B) Extractables

Fifteen hundred millilitres of water was spiked with fifteen micrograms of deuterated anthracene ($C_{14}D_{10}$) to 10 ppb. The water was made alkaline (pH 12) with 6N NaOH and extracted three times with methylene chloride (200 ml, 100 ml, 50 ml). The organic fraction was roto-evaporated and labelled "Base-neutral extract".

The alkaline water was made acidic (pH 2) with 6N HCl and spiked with fifteen micrograms of deuterated anthracene. The water was extracted three times with methylene chloride (200 ml, 100 ml, 50 ml). The organic fraction was roto-evaporated and labelled "Acid extract".

The extracts were analyzed by GC/MS on the Finnigan 4023 with the Incos Data System. One microlitre of two hundred microlitres of each extract was injected splitless onto a 30 metre DB-5 capillary column with a head pressure of 15 psi. The oven temperature was programmed from 30°C to 280°C @ 6°C/min. The mass range of 34-450 amu was scanned once per second.

C) Recovery Study

The following compounds were spiked to 10 ppb in pre-cleaned water and extracted and analysed in an identical manner to the proceeding samples:-

1.	Phenol (BP94)	74%
2.	Chloromethyl phenol (BP107)	123%
3.	n-Octylphthalate (BP149)	103%
4.	i-Octylphthalate (BP149)	103%
5.	D10-anthracene (BP188)	74%
6.	Benzo (k) fluranthene (BP252)	96%

DATE: March 2, 1982

SAMPLE: Test Well #1

ORIGINAL VOL/WEIGHT: 1500 mIs.

SAMPLE DESCRIPTION: Stouffville Water Sample

SUBMITTED BY: G. Foster

PROJECT # 820107

QUANTITATION BY: xxGC-MS EC FID

COMPOUND	AMOUNT
PURGEABLE GROUP	
Benzene	
Bromodichloromethane	
Bromoform	
Carbon tetrachloride	
Chlorobenzene	
Chloroform	
Dibromochloromethane and/or Cis-1,3dichloropropene	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1-Dichloroethylene	
Trans-1,2-dichloroethylene	
1,2-Dichloropropane	
Trans-1,3-dichloropropene	
Ethylbenzene	
Dichloromethane	* 129 ppb
1,1,2,2-Tetrachloroethane and/or 1,1,2,2-Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane and/or Trichloroethylene	
Trichlorofluoromethane	
ACID GROUP	
p-Chloro-m-cresol	
2-Chlorophenol	
2,4-Dichlorophenol	
2,4-Dimethylphenol	
4,6-Dinitro-o-cresol	
2,4-Dinitrophenol	
2-Nitrophenol	
4-Nitrophenol	
Pentachlorophenol	
Phenol	
2,4,6-trichlorophenol	

COMPOUND	AMOUNT
BASE NEUTRAL GROUP	
Polynuclear Aromatics:	
Acenaphthene	
Acenaphthylene	
Anthracene and/or Phenanthrene	
Benzo(a)anthracene and/or Chrysene	
Benzo(b)fluoranthene and/or Benzo(k)fluoranthene	
Benzo(ghi)perylene	
Benzo(a)pyrene	
Dibenzo(ah)anthracene	
Fluoranthene	
Fluorene	
Indeno(1,2,3-cd)pyrene	
Naphthalene	
Pyrene	
Chlorinated Benzenes:	
1,2-Dichlorobenzene	
1,3-Dichlorobenzene and/or 1,4-Dichlorobenzene	
1,2,4-Trichlorobenzene	
Hexachlorobenzene	
Nitrosamines:	
N-nitrosodimethylamine	
N-nitrosodiphenylamine	
N-nitrosodi-n-propylamine	
Phthalate Esters:	
Butyl benzylphthalate	
Di-n-butylphthalate	0.57 ppb
Diethylphthalate	
Dimethylphthalate	
Di-n-octylphthalate	

COMPOUND	AMOUNT
Bis-(2-ethylhexyl)phthalate	0.22 ppb
Haloethers:	
4-Bromophenyl phenyl ether	
Bis(2-chloroethoxy)methane	
Bis(2-chloroethyl)ether	
Bis(2-chloroisopropyl)ether	
4-Chlorophenyl phenyl ether	
Other Compounds:	
Benzidine	
2-Chloronaphthalene	
3,3'-Dichlorobenzidine	
2,4-Dinitrotoluene	
2,6-Dinitrotoluene	
1,2-Diphenylhydrazine	
Hexachlorobutadiene	
Hexachlorocylcopentadiene	
Hexachloroethane	
Isophorone	
Nitrobenzene	
PESTICIDE GROUP	
Aldrin	
alpha-BHC	
beta-BHC	
gamma-BHC(Lindane)	
delta-BHC	
Chlordane	
4,4'-DDD	
4,4'-DDT	
alpha-Endosulfan	
beta-Endosulfan	
Endosulfan sulphate	
Endrin	
Endrin aldehyde	
Heptachlor	
Heptachlor epoxide	
PCB's	
Toxaphene	
Dieldrin	
4,4'-DDE	

OTHERS	
C5-Phenol	0.07 ppb
Phenyl compound (?)	0.09 ppb

COMMENTS:

* Suspected Lab contamination during sample handling

DATE: March 2, 1982
SAMPLE DESCRIPTION: Stouffville Water Sample
SAMPLE: Test Well #2
ORIGINAL VOL/WEIGHT: 1500 ml
SUBMITTED BY: G. Foster
PROJECT #: 820107
QUANTITATION BY: xxGC-MS EC FID

COMPOUND	AMOUNT
PURGEABLE GROUP	
Benzene	
Bromodichloromethane	
Bromoform	
Carbon tetrachloride	
Chlorobenzene	
Chloroform	
Dibromochloromethane and/or Cis-1,3dichloropropene	
1,1-Dichloroethane	
1,2-Dichloroethane	
1,1-Dichloroethylene	
Trans-1,2-dichloroethylene	
1,2-Dichloropropane	
Trans-1,3-dichloropropene	
Ethylbenzene	
Dichloromethane	* 86 ppb
1,1,2,2-Tetrachloroethane and/or 1,1,2,2-Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane and/or Trichloroethylene	
Trichlorofluoromethane	
ACID GROUP	
p-Chloro-m-cresol	
2-Chlorophenol	
2,4-Dichlorophenol	
2,4-Dimethylphenol	
4,6-Dinitro-o-cresol	
2,4-Dinitrophenol	
2-Nitrophenol	
4-Nitrophenol	
Pentachlorophenol	
Phenol	0.03 ppb
2,4,6-trichlorophenol	

COMPOUND	AMOUNT
BASE NEUTRAL GROUP	
Polynuclear Aromatics:	
Acenaphthene	
Acenaphthylene	
Anthracene and/or Phenanthrene	
Benzo(a)anthracene and/or Chrysene	
Benzo(b)fluoranthene and/or Benzo(k)fluoranthene	
Benzo(ghi)perylene	
Benzo(a)pyrene	
Dibenzo(ah)anthracene	
Fluoranthene	
Fluorene	
Indeno(1,2,3-cd)pyrene	
Naphthalene	
Pyrene	
Chlorinated Benzenes:	
1,2-Dichlorobenzene	
1,3-Dichlorobenzene and/or 1,4-Dichlorobenzene	
1,2,4-Trichlorobenzene	
Hexachlorobenzene	
Nitrosamines:	
N-nitrosodimethylamine	
N-nitrosodiphenylamine	
N-nitrosodi-n-propylamine	
Phthalate Esters:	
Butyl benzylphthalate	
Di-n-butylphthalate	0.97 ppb
Diethylphthalate	
Dimethylphthalate	
Di-n-octylphthalate	

COMPOUND	AMOUNT
Bis-(2-ethylhexyl)phthalate	0.99 ppb
Haloethers:	
4-Bromophenyl phenyl ether	
Bis(2-chloroethoxy)methane	
Bis(2-chloroethyl)ether	
Bis(2-chloroisopropyl)ether	
4-Chlorophenyl phenyl ether	
Other Compounds:	
Benzidine	
2-Chloronaphthalene	
3,3'-Dichlorobenzidine	
2,4-Dinitrotoluene	
2,6-Dinitrotoluene	
1,2-Diphenylhydrazine	
Hexachlorobutadiene	
Hexachlorocylcopentadiene	
Hexachloroethane	
Isophorone	
Nitrobenzene	
PESTICIDE GROUP	
Aldrin	
alpha-BHC	
beta-BHC	
gamma-BHC(Lindane)	
delta-BHC	
Chlordane	
4,4'-DDD	
4,4'-DDT	
alpha-Endosulfan	
beta-Endosulfan	
Endosulfan Sulphate	
Endrin	
Endrin aldehyde	
Heptachlor	
Heptachlor epoxide	
PCB's	
Toxaphene	
Dieldrin	
4,4'-DDE	

OTHERS	
C_5-Phenol	0.33 ppb
Phenyl compound (?)	0.04 ppb

COMMENTS:

* Suspected Lab contamination during sample handling

(9132)
MOE/WHI/AMVR

DATE DUE

MOE/WHI/AMVR
Ontario Ministry of the En
Whitchurch-Stouffvill
e chemical testing amvr
c.1 a aa